

**AFTER ACTION REPORT**

**ON**

**MAINTENANCE DREDGING - CHARLESTON ENTRANCE CHANNEL**

**IFB NO. DACW60-96-B-0017, 28 AUGUST 1996**

**CONTRACT NO. DACW60-97-0004, 10 JANUARY 1997**

**BEAN DREDGING CORPORATION**

**DREDGE EAGLE 1**

**16 MAY 1997**

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BEAN DREDGING CORPORATION  
DREDGE EAGLE I

1. GENERAL

An Investigation Team was appointed and funds were provided on 10 April 1997 to investigate and document events that led to suspension of work under Contract No. DACW60-97-0004, signed 10 January 1997, for removal of material from Charleston Harbor Entrance Channel.

2. PURPOSE

Dredging in Charleston Entrance Channel was suspended on 26 March 1997 because the incidental take of loggerhead sea turtles (20 for the South Atlantic Division) had reached a critical number (18) which had led to possible suspension of all SAD dredging activities, including the Myrtle Beach Storm Damage Reduction Project. The purpose of this investigation was to gather and evaluate all coordination correspondence, procurement documents, quality control reports, quality assurance records and other available information to accurately document events that led to suspension of work and to develop conclusions and recommendations designed to avoid similar future incidents.

3. PROJECT CHRONOLOGICAL HISTORY

The sequence of events that led to suspension of Entrance Channel dredging work, began in October 1995 when the barge, Patricia Sheridan, grounded beside the Charleston Harbor Entrance Channel spilling sediments containing a variety of contaminants including dioxin. The responsible party was required to remove contaminated sediment from a four-acre area surrounding the grounding site. However, material was not removed from the entrance channel which was only about 200 feet from the grounding site. The following table provides a chronology of events that contributed to and led to suspension of work:

DATE	EVENT
Oct 1995	The barge <u>Patricia Sheridan</u> grounded near the Entrance Channel spilling contaminated sediments.
Jan 1996- Feb 1996	As required by the Corps of Engineers, the Coast Guard and environmental resource agencies, the responsible party removed contaminated sediment from a 4-acre area surrounding the grounding site. The 4-acre site was designated by the Corps. The Corps elects to not include the Entrance Channel in the clean-up area.
Mar 1996	Coordination with EPA for Entrance Channel dredging and ODMDS disposal indicates that testing would be required on Entrance Channel sediments.
Apr 1996	Coordination through the U.S. Coast Guard (Federal POC) to the responsible parties is initiated to sample and test Entrance Channel sediments. After considerable coordination, the responsible parties reach agreement with the Corps, Coast Guard and environmental agencies to collect samples and conduct chemical testing, but not biological testing.

DATE	EVENT
Jun 1996	Sediments samples collected in the Entrance Channel.
Aug 1996	Sediment chemical test results received indicating that low level metals and some dioxin were present in the sediment. The results were submitted to EPA.
28 Aug 1996	Invitation for Bids for Entrance Channel dredging (IFB DACW60-96-B-0017).
5 Sep 1996	EPA relocated to a new office causing delay in response.
9 Sep 1996	Amendment No. 1 to IFB extending bid opening date until further notice.
1 Oct 1996	EPA requires bioassay testing of Entrance Channel sediment.
Nov 1996	Bioassay tests indicated 100% mortality at three of the four sampling stations. LC-50's (lethal concentrations to 50% of the organisms in a sample) ranged from 16% to 70%. Based on these results, EPA required the Corps to run the STFATE model to determine impacts after four hours at the disposal site.
26 Nov 1996	Amendment No. 2 to IFB setting new bid opening date and including an additional disposal area.
2 Dec 1996	Model results indicate that two of the three sites that failed the toxicity tests passed the model and one site is inconclusive. Based on these results, Charleston District proceeds with coordination and submits data to EPA.
11 Dec 1996	EPA decides that STFATE model results were inconclusive and requires the Corps to rerun the model.
Dec 1996 - Jan 1997	Charleston District contractor reruns the STFATE Model and Charleston District submits Evaluation of model results and supportive documentation as required by Section 103 of the Marine Protection Resources & Sanctuaries Act (MPRSA) to EPA for concurrence.
8 Jan 1997	Letter from EPA approving ODMS for disposal of Entrance Channel material.
10 Jan 1997	Contract DACW60-97-C-0004 is signed. Special Contract Requirements state that: "Dredging may start anytime after notice to proceed is issued but no sooner than 15 November 1996; however, all work shall be completed no later than 15 April 1997".
12 Feb 1997	Preconstruction Conference
12 Feb 1997	Notice to Proceed (NTP) Charleston Contact
20 Feb 1997	Jacksonville District Contract DACW60-97-C-0038 is signed with Bean Dredging Corp. to conduct dredging at Kings Bay.
28 Feb 1997	Jacksonville issues NTP at Kings Bay. Required completion date is 15 Apr 1997.
1 Mar 1997	Eagle 1 begins dredging at Kings Bay.
2 Mar 1997 - 12 Mar 1997	Nine (9) loggerhead turtles killed by Eagle 1 at Kings Bay. Work is suspended 13 Mar 1997.
14 Mar 1997	Eagle 1 begins dredging in Charleston Entrance Channel.
19 Mar 1997	First loggerhead turtle killed by Eagle 1 in Charleston Entrance Channel.
20 Mar 1997	Second loggerhead turtle killed by Eagle 1 in Charleston Entrance Channel.
20 Mar 1997	Glynn Banks (WES) and Jim Mims (COR) aboard Eagle 1.
21 Mar 1997- 26 Mar 1997	Third, fourth and fifth loggerhead turtles killed by Eagle 1 in Charleston Entrance Channel. Total killed in SAD during CY 1997 = 18. (Limit established by NMF is 20)
26 Mar 1997	Dredging work in Charleston Entrance Channel suspended. Eagle 1 leaves Charleston and proceeds to New Orleans.

#### 4. OPERATIONAL HISTORY OF BEAN DREDGING CORPORATION DREDGE EAGLE 1

The following information on Bean Dredging Corporation hopper dredge, Eagle 1 was obtained from HQ and the various districts listed below. Information from Mobile District indicated that although there are sea turtles in the district which must be protected during beach nourishment project construction, there has never been a documented turtle take by a hopper dredge working in a Mobile District navigation channel. Mobile, therefore, does not have the same turtle-related problems as other SAD districts and does not require turtle observers on hopper dredges. New Orleans District, who has used Eagle 1 more than SAC, SAS, SAW and SAJ combined from FY1990 to FY1997, have had no documented incidents of turtle takes by this dredge. Between 14 October and 19 November 1996, Eagle 1 worked on LMN's bar channel, removing 1.5 million cubic yards with no turtle takes. From 19 November 1996 - 21 January 1997, Eagle 1 dredged 2.3 million cubic yards from MR-GO and Southwest Pass with no turtle incidents. However, there were five turtle takes by other government contract dredges working in the same areas during the period October-December 1996 (Ouachita, Manhattan Island and Padre Island). Prior to FY1995, New Orleans did not require turtle observation. Although Eagle 1's March 1997 performance at Kings Bay and Charleston accounted for an unusually large number of turtle kills, the number of kills at Charleston per cubic yards dredged was similar to the kill/CY ratio of the Ouachita working in Savannah Harbor during the same period (see Appendix S). Mr. Chris Slay, President of Coastwise Consulting, who provides NMFS-approved observers for dredging operations, provided information (copy in Appendix J) indicating that Eagle 1 had an extremely good turtle-take record working on six SAD projects, one LMN project and one SWG project from 1992 to 1997. During that period, in 348 days of monitoring onboard the Eagle 1, only one turtle take was documented. In Mr. Slay's opinion, Eagle 1 is no more likely to take turtles than any other hopper dredge its size. Based on available information, it appears that with the exception of the March 1997 Kings Bay job, the Eagle 1's turtle kill record is no worse than those of other large hopper dredges.

#### OPERATIONAL RECORD OF BEAN DREDGING CORPORATION DREDGE EAGLE 1

FY	DISTRICT	JOB NAME (LOCATION)	TURTLE KILLS	H2O temp (F)
90	LMN	MS RIV SWP LSD HPR #1	no observers	
90	LMN	MS RIV SWP LSD HPR #3	no observers	
91	LMN	MS RIV SWP LSD HPR #3	no observers	
91	LMN	MS RIV SWP LSD HPR #1	no observers	
91	LMN	MS RIV SWP LSD HPR #6	no observers	
91	LMN	MS RIV SWP LSD HPR #5	no observers	
92	SAJ	KINGS BAY	0	
92	SAM	MOBILE HARBOR	no observers	
92	SAW	MOREHEAD CITY HBR OCEAN BAR		
93	LMN	MS RIVER, SWP LSD HPR #2	no observers	
93	LMN	MS RIVER, SWP LSD HPR #4-92	no observers	
93	SAM	PASCAGOULA HARBOR, MS BAR	no observers	
93	SAM	MOBILE HARBOR, AL BAY	no observers	
93	SAS	BRUNSWICK ENTRANCE CHANNEL	1 loggerhead	
93	SAW	WILMINGTON & MOREHEAD CITY BAR	0	57-59
94	LMN	MS RIV SWP LSD HPR #6-94	no observers	
94	SAM	MOBILE HARBOR, AL	no observers	
94	SAW	MOREHEAD CITY HARBOR	0	57-59
95	LMN	MS RIVER SWP LSD HPR #5-95	0	
95	SAJ	KINGS BAY EC & TAC	0	56-57

# OPERATIONAL RECORD OF BEAN DREDGING CORP. DREDGE EAGLE 1 (continued)

FY	DISTRICT	JOB NAME (LOCATION)	TURTLE KILLS	H2O temp (F)
95	SAM	MOBILE HARBOR, AL BAY	no observers	
95	SAM	MOBILE HARBOR, AL BAY	no observers	
95	SAW	MOREHEAD CITY OCEAN BAR	0	50+
96	SAM	MOBILE BAY, AL	no observers	
97	LMN	MS RIV SWP LSD HPR #4-96	0	
97	LMN	MS RIV SWP LSD HPR #6-96	0	
97	LMN	MS RIV SWP LSD HPR #8-97	0	
97	SAC	CHARLESTON ENT CHANNEL 97	5 loggerhead	61
97	SAJ	KINGS BAY EC	9 loggerhead	57-58
97	SWG	FREEPORT, EMER ENT CHANNEL	0	56-59

## 5. ENDANGERED SPECIES ACT COORDINATION

In July 1995, the U.S. Department of Commerce, NOAA, National Marine Fisheries Service provided a Biological Opinion which concluded formal Endangered Species Act Section 7 consultation on hopper dredging of channels and beach nourishment activities in the southeastern United States from North Carolina through the Florida east coast. The Biological Opinion includes an Incidental Take Statement which includes numbers of various endangered species which can be taken per year by hopper dredges, and procedures required when take limits are approached. The Biological Opinion also includes measures, including windows of operation, which NMFS believes are necessary to minimize endangered species damage. These measures are included in the hopper dredge specifications of affected Corps Districts (Appendices L-R). A copy of the Biological Opinion is included in Appendix A.

## 6. FACTORS RELATING TO TURTLE KILLS

a. Schedule. Although sea turtles are occasionally found in Charleston Harbor and other south Atlantic harbors during winter months, they are much less abundant when water temperatures are below 55 degrees F. It is therefore very important to schedule South Atlantic dredging activities during the winter months. The original schedule for Charleston Entrance Channel dredging had a construction window of 15 November to 12 February. If this schedule could have been maintained, there probably would have been few if any turtle kills. The Entrance Channel schedule slippage was caused by the sequence of events described in paragraph 3, beginning with the barge grounding incident. When EPA coordination for Entrance Channel dredging was finally completed on 8 January 1997, the modified specifications allowed the contractor a construction window from NTP date (12 February 1997) to 15 April 1997. Following signature of the Charleston contract, the contractor proceeded to Jacksonville and signed another contract (on 20 February 1997) to dredge Kings Bay using the same dredge that he intended to use at Charleston. The dredge did not start working in Charleston until 14 March, one month after NTP. During the Kings Bay job (3/1/97-3/12/97) water temperature was 57-58 degrees F and nine loggerheads were taken. By the time Eagle 1 started in Charleston (3/14/97) water temperature was 61 degrees F and five Loggerheads were taken before work was suspended on 3/19/97.

b. Endangered Species Specifications. Section 01435 of the General Requirements of Charleston District Contract DACW60-96-B-0017 covers Compliance with the Endangered Species Act (Appendix L). This section is mostly concerned with compliance requirements to monitor turtle takes (screens, observers, floodlights, observers reports, processing of dead and live turtles, notification, etc.). There are only two paragraphs which are designed to avoid killing turtles, paragraph 3.3.2: Turtle Deflector Device, and paragraph 3.3.4: Hopper Dredge Operating Restrictions. Turtle deflector requirements include approval of the device by the COR and requirements that the device be designed to stay parallel to the bottom at the operating depth. Hopper dredge operating requirements state that dredge pumps shall not be operated while the draghead is suspended in the water column and that pumps shall only be started when the dragheads are firmly on the bottom. Jacksonville hopper dredge specifications are essentially the same as Charleston's except that Jacksonville had modified their specifications to allow suction pumps to be operated just enough to clear the lines after the draghead is lifted. There are no penalties or other incentives designed to avoid killing turtles. Both Galveston and New Orleans District hopper dredge contract specifications include paragraphs that warn contractors that they shall be held responsible for any turtles harmed, harassed, or killed as a result of construction activities not conducted in accordance with the specifications. The draghead design requirements may be adequate, but it would require some degree of training to inspect one of these devices and determine if it would, in fact, run parallel to the bottom at the required dredging depth. There may be other draghead design factors (such as free water ports and water jet ports) which would contribute to protection of turtles and could be included in the specifications. If there are such factors, draghead design experts at WES should be able to provide advice and training to district personnel at workshops. The requirement that pumps not be operated while the draghead is suspended in the water column cannot be enforced (without 24-hour inspection) and may not be practical because it may not be possible to always clear the lines without operating the pumps. That is probably why Jacksonville specifications were modified to allow the pumps to be run just enough to clear the lines.

c. Dredging Specifications. The Charleston District hopper dredging specifications require that each shoal be dredged in its entirety before dredging commences on the next shoal. This is considered necessary to document (by hydrographic survey) how much material has been removed from the channel and how much to pay the contractor. This requirement causes the dredge to go back and forth making short runs and many turns in order to complete all dredging in one shoal before the work is accepted and he is allowed to proceed to the next shoal. Every time the dredge turns, the dragheads must be lifted, then lowered, increasing the chance of turtle takes. It also results in inefficiency. Glynn Banks suggested operational modifications to dredge through all reaches on one pass to reduce turns (outlined in the following paragraph) would not be in accordance with the present Charleston District Entrance Channel specifications. In order to operate in the manner suggested by Mr. Banks, it would be necessary to change the method of material measurement and payment. Payment by bin load would be one alternative.



d. Operations. Glynn E. Banks, WES Research Hydraulic Engineer who designed the turtle deflector draghead attachment, made the following notes on 20 March 1997 after being aboard the Eagle 1 and observing it operating in the Charleston Entrance Channel. Mr. Jim Mims, contract COR was also present. Mr. Banks' notes reflect his ideas and suggestions as to how Eagle 1 operation could be altered to reduce turtle takes. Comments in parentheses are not Mr. Banks, but are provided for further explanation.

1. Dredge through all reaches on one pass in order to reduce turns. (This is to reduce the number of turns which requires lifting the draghead. Every time the draghead is lifted off the bottom, it increases the chance of taking turtles).
2. Use less teeth on the tail section of dragheads since a complete row of teeth may trap turtles being rolled in mud flow. (The teeth on the Eagle 1 draghead were removable and were not needed to work in soft material).
3. Specify order of work: From innermost sections working outward toward the toe of the slope. (This suggestion was made because the Eagle 1 was working close to the toe of the channel and the starboard draghead was being lifted often to prevent damage to the dragpipe).
4. Try to stay 50 feet off the toe at all times in order to prevent raising dragheads when vessel squirms off the designed track line. (Again, this is to reduce the number of times the draghead would have to be lifted off the bottom to prevent damage to the dragpipe).
5. Continue to pull back on the pumps when raising dragheads and implement a policy of holding the draghead on the bottom a minimum of 15 seconds after pumps are completely at idle position, 75 RPM. (This means, if the draghead must be lifted because of reduced pipeline velocities or other reasons, reduce pump RPM to idle speed before lifting it, and when putting it back down, keep the pump at idle for at least 15 seconds after the draghead reaches the bottom).
6. Keep dragpipe at straight condition which should keep draghead at about 16 degrees from horizontal which is the design angle of deflection. (The dragpipe is jointed in the middle with a dragtender cable attached to the joint (timble). If the timble is raised, it changes the angle of the draghead with respect to the bottom. If the angle is correct with the pipe straight, raising the timble would lift the front of the draghead and reduce the effectiveness of the turtle deflector).
7. If the drag tenders continue to have to raise dragheads off the bottom more than two times on one pass due to reduced pipeline velocities, require the contractor to install a screened opening on top of the draghead to allow a more uniform pipeline velocity and thus greater production efficiency. (Some draghead are equipped with openings of the type described).

Mr. Banks is of the opinion that if the dredge was operated in the manner reflected by the procedures above, that it would have resulted in greater dredging efficiency and fewer turtle takes. One of the problems observed by Mr. Banks was that the dredge pilot was not being careful about staying the proper distance from the toe of the channel. When the dredge got too close to the toe (which was often) the starboard dragtender would lift the starboard draghead to keep the dragpipe from going under the dredge (which would cause damage to the dragpipe). Mr. Banks believes that it would be

in the best interest of the contractor, the Corps and the turtles if dredge operation could concentrate on making long, straight runs and keep the dragheads on the bottom. As mentioned in paragraph 6c above, in order to operate in the manner suggested by Mr. Banks, the present method of determining material dredged and method of payment would need to be changed.

e. Equipment. Hopper dredge equipment which can be modified to influence turtle takes is mostly confined to the draghead-turtle deflector arrangement. There are several types of dragheads available and all can be fitted with turtle deflectors. Some dragheads have teeth or scrapers on the bottom to break up hard material and some don't. Eagle 1 dragheads had removable teeth which were probably responsible for several turtle takes, and the teeth were removed (at the suggestion of Glynn Banks) during the Charleston job. Some of the dragheads have free water ports and some have water jet ports designed to insert water and keep the slurry moving through the dragpipe. Some systems have no water ports and some have water ports which can be blocked off. Eagle 1 had water jet ports on both dragheads but had them blocked off because the contractor did not think they were necessary in the soft material found in the Charleston Entrance Channel. Eagle 1 also had a spare California draghead on board that had a free water port. Observation of Eagle 1 operations indicated that dragheads often had to be raised in the water column to increase suction (which increases the chance of taking turtles). Possibly, some of this could have been avoided if the water jet ports had been open. Charleston District hopper dredge contracts require turtle deflectors and require that the draghead-deflector arrangement be inspected and approved by the COR. Unfortunately, most districts, including Charleston have no one who has been trained to inspect these devices and determine whether or not they will work.

f. Dredge Material and Type of Bottom. Another problem which contributes to turtle takes is the material being dredged and the type of bottom. Portions of the Charleston Entrance Channel has a sandy bottom and the turtle deflectors normally work well on smooth, sandy bottoms because the front of the deflector (if designed properly) pushes a mound of material ahead of the draghead and pushes the turtles gently out of the way. Portions of the Entrance Channel have a hard clay bottom and sideslopes and the maintenance material to be removed is very soft, in some cases semi liquid pluff mud. The COR observed, during the Entrance Channel job, that the contractor had the draghead suspended at grade below the top of the mud, but not resting on the hard bottom. The reason for this is that the maintenance material will not support the weight of the draghead and the contractor does not get paid for dredging below grade. Turtles often bury in the mud and some turtles could be resting on the hard bottom below the 5-6 foot mud column. If this is true, the turtle deflector would offer no protection. Other bottom conditions such as irregular, rocky bottoms like Wilmington Harbor Ocean Bar Channel would also render turtle deflectors ineffective.

g. QAR, QCR & Turtle Reports. The following table summarizes turtle-related comments found in the Contractor's Quality Control Reports (QCR), the Government Quality Assurance Report (QAR), the Endangered Species Observers Report (Turtle Report), and any other pertinent information. These reports were carefully reviewed and no information was found that indicated deficiencies relating to turtle takes. Copies of these documents are included in the report appendices.

Date	QCR	QAR	TURTLE REPORT
3/14/97	Turtle screens and deflectors in place. Three turtle observers on board	Found deflector to be different in design than those on other dredges. Concerned about angle of attack and length of teeth.	None, no observers on board at 1555

Date	QCR	QAR	TURTLE REPORT
3/15/97	Turtle screens and deflectors in place. Three turtle observers on board	No site visit	Shoal 4, clear to partly cloudy, wind variable, H2O surface 60-62, H2O below mid-depth 60-61, material: sand, shell, mud & silt. No turtles taken.
3/16/97	Turtle screens and deflectors in place. Three turtle observers on board	No site visit	Shoal 4, clear, wind NNE 5-25K, H2O surface 62, H2O below mid-depth 61-62, material varies, sand, shell, mud & silt. Specimens: H-crabs, whelks, flounder. No turtles taken.
3/17/97	Turtle screens and deflectors in place. Three turtle observers on board	No site visit	Shoal 4, clear to pc, wind NE-SE, H2O surface 60, H2O below mid-depth 60, material varies, sand, silt & aggregate. Bos'n fabricated access ladder to mid-ship inflow basket as per COE. No turtles taken.
3/18/97	Turtle screens and deflectors in place. Three turtle observers on board	Arrived 1045, both Corps & contractor survey boats working, No turtles, No deficiencies.	Shoal 4, clear to pc, H2O surface 60, H2O below mid-depth 61, material varies, sand, silt & marl. No turtles taken.
3/19/97	Turtle screens and deflectors in place. Three turtle observers on board.	No site visit	Shoals 4,3,1; pc/rain, wind W-SW-E 5-20K, H2O surface 60-61, H2O below mid-depth 59-60, material: #4-sand/marl, #3-mud, #1-mud/sand. Turtles (L) taken in shoal #1. See Appendices D & E
3/20/97	Turtle screens and deflectors in place. Three turtle observers on board. Glenn Banks suggestions noted in block 4 of QCR	J. Mims, Glenn Banks, R. Thomas on board. Turtle (L) taken at 0930. G. Banks & dredge captain agreed to remove teeth from starboard draghead as experiment. G. Banks prepares site visit memo. See Appendix J	Shoals 1; pc, wind 5-10K, H2O surface 60, H2O below mid-depth 60, material: mud & hard clay. Turtles (L) taken in shoal #1. See Appendices D & E
3/21/97	Turtle screens and deflectors in place. Three turtle observers on board. Found live turtle in starboard dragarm.	No site visit	Shoals 1; clear/cloudy/pc, wind 5-17K, H2O surface 61-64, H2O below mid-depth 60-62, material: soupy silt & clay. Turtles (L) caught live and in good condition at shoal #1. Turtle was turned over to SCDNR. See Appendices D & E
3/22/97	Turtle screens and deflectors in place. Three turtle observers on board.	0830-dredge heading to disposal site. Pumps were running going to and from disposal site. Inspector told that engine was in "neutral".	Shoals 1; clear, wind 5-10K, H2O surface 62-76, H2O below mid-depth 60-62, material: soupy silt & clay. No turtles taken.
3/23/97	Turtle screens and deflectors in place. Three turtle observers on board.	1030: Turtle trawler running ahead of dredge as it makes a long run from #3 to #2 to #1. Very windy. No turtles.	Shoals 1,2,3; clear, wind 5-15K, H2O surface 62-76, H2O below mid-depth 60-61, material: soupy silt, mud & clay balls. Horseshoe crabs, whelks, stingrays. No turtles taken.
3/24/97	Turtle screens and deflectors in place. Three turtle observers on board.	No site visit	Daily report illegible - No turtles taken.

Date	QCR	QAR	TURTLE REPORT
3/25/97	Turtle screens and deflectors in place. Three turtle observers on board.	Inspector arrived at 0900 and left at 1600. No notes regarding turtle kill were recorded.	Shoal 2 & 3; H2O surface 63, H2O below mid-depth 62. Turtle (L) taken by starboard draghead.
3/26/97	Turtle screens and deflectors in place. Three turtle observers on board.	No site visit	Shoal 2 & 3; H2O surface 63, H2O below mid-depth 62. Turtle (L) found on aft port screen.

## 7. LESSONS LEARNED

a. Schedule. Schedule control is probably the most important factor in preventing turtle kills. If hopper dredging is conducted in South Atlantic shipping channels when water temperatures are above 55 degrees F, sea turtles are likely to be in the channels in abundance.

b. Endangered Species Specifications. The districts most concerned with sea turtle - hopper dredge problems are SAC, SAS, SAJ, SAW, SWG, and LMN. All of these districts have endangered species compliance requirements in their hopper dredge specifications (Appendices L-Q). These requirements are designed to monitor turtle takes, i.e., screens, observers, flood lights, observers reports and processing of dead and live turtles. These districts also have specification requirements to make sure turtle deflectors are designed properly and to prevent dredge operators from operating pumps while dragheads are suspended in water column. LMN and SWG both have a paragraph in their specs warning that contractors shall be held responsible for any turtles harmed, harassed, or killed as a result of construction activities not conducted in accordance with specifications. None of the districts have tried incentives or penalties designed to encourage contractors to avoid taking turtles.

c. Dredging Specifications. Dredging specifications differ from district to district for various reasons. In each district, the process of coordination, solicitation, construction, inspection and payment has been selected to best fit the needs of the district. Until now, endangered species requirements have been addressed with monitoring requirements and turtle deflector draghead requirements. If these measures are found to be inadequate, other measures may need to be explored. Paragraph 6d lists Glynn Banks' suggestions for operational procedures that would result in fewer turtle takes. Lessons learned from reviewing the Charleston Entrance Channel Specifications indicate that the present procurement strategy will require drastic modifications in order to operate in the manner that Mr. Banks has suggested.

d. Operation. During Glynn Banks 20 March 1997 observation of Eagle 1 operation in Charleston Entrance Channel, he listed the operational modification suggestions listed in paragraph 5c. Lessons learned from these suggestions are that, in order to minimize turtle takes, hopper dredges should be equipped and operated in a manner which will:

- (1) Keep dragheads on the bottom at the proper design angle.
- (2) Minimize the number of times that dragheads need to be raised in the water column to increase suction.
- (3) Avoid taking turtles when dragheads must be raised in the water column by reducing pump RPM.
- (4) Avoid use of unnecessary turtle damaging equipment such as teeth or scrapers which are not needed in soft material.

e. Equipment. Corps personnel observations of Eagle 1 operation in Charleston Entrance Harbor indicated that suction was often lost and dragheads had to be raised to increase water intake and increase suction. It has been suggested by several that dragheads equipped with free water ports or water jet ports have less problems becoming clogged and losing suction. The COR remembered that the Eagle 1's dragheads had water jet ports, but they had been blocked off because the contractor did not believe that they would be necessary in Charleston's soft material. Also, there was another California-type draghead on board that was equipped with a free water port. It is possible that unblocking the water jet ports on the Eagle 1 dragheads could have resulted in fewer turtle takes.

f. Dredge Material and Type of Bottom. A lesson learned (from the COR) is that the Eagle 1 had the dragheads suspended at grade below the top of the mud, but not resting on the hard bottom. The reason for this is that the maintenance material will not support the weight of the draghead and the contractor does not get paid for dredging below grade. Turtles often bury in the mud and some turtles could be resting on the hard bottom below the 5-6 foot mud column. If this is true, the turtle deflector would offer no protection to turtles resting on the hard bottom.

g. Quality Control - Quality Assurance. Based on a review of all QA/QC documents, it appeared that the contractor met all QC requirements, including those that pertained to endangered species, and that the COR and inspectors met all QA requirements. These documents indicated that three turtle observers were present on the dredge throughout the entire operation and filled out their required log sheets daily. Lessons learned regarding QA / QC / endangered species requirements are that the requirements specified, if practical, will be probably be met; however, it is not likely that any of the specified requirements will be "exceeded" to reduce turtle damage or for any other reason that is not beneficial to the contractor. If we want the contractor and the QA personnel to take additional turtle-saving action, such action must be practical, reasonable, enforceable and clearly specified in the contract.

## 8. CONCLUSIONS & RECOMMENDATIONS

a. Schedule. South Atlantic Division should provide leadership to initiate action to provide a coordinated Corps-wide effort to establish hopper dredge priorities based on all factors including endangered species. Based on the level of importance of sea turtle protection and preservation as compared to other priority factors, consideration should be given to assure that dredging of South Atlantic harbors and other U.S. waters with significant sea turtle populations, is conducted during the winter months when turtles are less abundant. Schedules should be established early enough to allow Corps-wide coordination to establish priorities for turtle-critical districts to have access to available hopper dredges during winter months. The contract process should be started early enough to allow time for unforeseen problems to be resolved. The dredging window used in previous Charleston District contracts (15 November-15 April) proved to be too wide during a warm winter as occurred in 1996-97. Since winter severity cannot be predicted in July when IFB normally occurs, the construction window may need to be narrowed; possibly from 1 December -31 March. Also the specifications may need to require a starting date no later than (some date depending upon size of job). Another factor which should be considered in establishing hopper dredge priorities is material and bottom conditions. Harbors which have bottom conditions which cause draghead turtle deflectors to be ineffective (hard, rocky, uneven, pluff mud, etc.) could be given higher priority for winter-month scheduling. Recommend that NMFS and WES be part of the process.

b. Endangered Species Specifications. Under SAD leadership, SAD districts with turtle problems and other interested districts such as LMN and SWG should form a committee of CO, CT, and Environmental Resource people to review all district hopper dredge endangered species-related specifications and make recommendations for changes designed to cause dredging contractors to reduce turtle kills. There are presently no turtle-related penalties or incentives in any of the contract documents reviewed during this study and careful consideration should be given to including some. Some believe that anticipated penalties will be included in bid prices from all bidders. Some felt that penalties would be unreasonable because turtle takes are influenced by numerous outside parameters (water temperature, number of turtles, type of bottom, type of material, swells, etc.) which cannot be controlled by the contractor. Others believe that dredge operators who know how to operate in a turtle-saving manner will bid lower than those who don't or who don't care to. Incentives or bonuses may be another option. It is recommended that representatives from WES, the dredging industry and a procurement specialist be included on the committee.

c. Dredging Specifications. One of the most significant factors contributing to turtle takes appears to be method of operation. During Glynn Banks observation of Eagle 1 operation in Charleston Entrance Channel (20 March 1997) he made operational suggestions which are listed in paragraph 6d and summarized in his 4 April 1997 Memorandum for Record (Appendix I). The basic objective of his operational suggestions was to cause the dredge to make long, straight runs, minimize turns and keep the dragheads on the bottom. The present Charleston Entrance Channel specifications are not designed to allow this type of operation. It is recommended that Charleston District solicit the assistance of a dredging procurement specialist and explore alternative methods of dredge material measurement and payment to determine if there is a workable procurement solution that will cause the contractor to operate in the manner suggested by Mr. Banks. Mr. Banks has indicated that he will be glad to assist in this endeavor.

d. Operations. In order to cause contractors to operate in a turtle-saving manner, districts must design specifications in a way that will cause contractors to operate in the desired manner as discussed in paragraph 8c above. The challenge will be to do this in a way that will still allow cost effective harbor maintenance. Since each harbor, shoal, bar, channel, etc., is unique, procurement strategy should be developed at district level for each dredging contract.

e. Equipment. Charleston District hopper dredging specifications now require turtle deflectors, have drawings of turtle deflectors, and require that the COR inspect and approve turtle deflectors. Interviews with people who have seen and inspected these deflectors admit that they can't tell by looking at one whether or not it will effectively deflect turtles. Also, there are several types of dragheads, some of which may be more effective than others for particular types of bottom conditions and dredging situations. Information is needed concerning which dredges and draghead types will work best to prevent turtle takes in each South Atlantic harbor and other harbors that have significant turtle populations. It is recommended that WES be given the responsibility (and funds) to inspect the hopper dredge fleet and provide this information to all concerned districts. The effectiveness of dragheads equipped with free water ports and water jet ports in various harbors and bottom conditions should also be addressed during this endeavor.

f. Dredge Material and Type of Bottom. In some cases, due to bottom conditions or other situations where turtle deflectors provide less protection and operational modifications designed to protect turtles are ineffective, the only options may be strict schedule control, trawling, or use of cutterhead

dredges. Such decisions should be part of the procurement strategy process for each dredging contract and should be made at the district level with close NMFS and WES coordination.

g. Quality Control - Quality Assurance. Any changes in procurement methods could require changes in QC/QA procedures. For instance, if it is decided that long straight runs through all of the entrance channel shoals are necessary (for turtle preservation) it might be more practical to pay by bin load rather than for quantity excavated. If this method is adopted, it is likely that government inspectors or Title II inspectors would need to be on board 24 hours per day to make sure the contractor is dredging in the channel. Recommend that QC/QA modifications be considered in conjunction with the other actions recommended above.

## 9. SUMMARY OF FINDINGS

The following summarizes findings of the study team:

- a. Bean Dredging Corporation Dredge Eagle 1 has a relatively good turtle-take record and is not to blame for the series of incidents that led to suspension of the Charleston Entrance Channel project.
- b. Unavoidable factors that contributed to turtle takes and suspension of work on the Charleston Entrance Channel project included a warm winter, abundance of turtles, shortage of hopper dredges and possibly the type of material being dredged.
- c. Avoidable factors that contributed to turtle takes and suspension of work on the Charleston Entrance Channel included schedule slippage and specified contract performance windows.
- d. Other factors which could have impacted the project and could be altered for possible improvement by specification changes, include method of operation and equipment.
- e. Good scheduling is probably the best and least disruptive method of reducing turtle takes. If Charleston District could schedule all of their hopper dredging during December, January and February, there would be few turtle takes. However, there are at least six districts with significant turtle problems who would also like to get their hopper dredging done during the winter and there are other districts that may not have turtle problems, but who have other reasons for needing their channels dredged during the winter. The hopper dredge fleet is not always able to accommodate all Corps needs. Therefore, good scheduling is not always possible and is not the ultimate answer to the turtle problem. The best solution is probably a regional priority system that considers all factors including turtles.
- f. Type of bottom and type of material to be dredged should be considered in establishing hopper dredging priorities and approval of equipment. There are several types of dragheads and some draghead-turtle deflector systems may work better in some harbors than in others. District personnel do not have the training to look at one of these devices and tell whether or not it will work on specific dredging jobs. In some harbors, it is possible that deflectors are totally useless and should not be used at all. WES assistance is needed to make these determinations to help establish regional or Corps-wide priorities and to help districts determine which dredges are best suited to operate in their harbors.

g. None of the districts interviewed (LMN, SWG and all SAD districts) have attempted to reduce turtle takes by using penalties or incentives in their hopper dredging specifications. This is probably because it is assumed that the contractors will all bid higher because their ability to operate in a manner that is less conducive to turtle takes is limited by Corps specifications. Also, experience people interviewed felt that penalties and incentives were unreasonable because turtle takes are influenced by numerous outside parameters (water temperature, number of turtles, type of bottom, type of material, swells, etc.) which cannot be controlled by the contractor. Glynn Banks observation that the Eagle 1 could have avoided turtle takes by making long, straight runs through all of the shoals is probably true. However, the contractor could not operate in this manner because the specifications required that he finish each shoal in its entirety before dredging commences on the next shoal. This is because the Charleston District contract pays for cubic yards excavated from the channel and the material washes back into the dredged area so fast that the Corps requires the contractor to completely finish each shoal before it is surveyed it to document how much has been removed (for pay purposes). After a shoal has been surveyed and accepted, the Corps allows the contractor to start work on the next shoal. This causes the contractor to go back and fourth over short distances, making many turns and lifting and lowering his dragheads often which increases the chance of taking turtles. Glynn Banks suggested MO would keep the draghead on the bottom longer and reduce the number of turns drastically. In his opinion, this would not only help preserve turtles, but would result in a more efficient operation. If this method of operation were adopted it would probably not be feasible to use the current method of documentation (amount excavated determined by hydrographic surveys) for pay purposes. It would probably be necessary to measure quantity excavated by bin load. Theoretically, this would cause the contractor to fill and dump the hopper as quickly and efficiently as possible with a minimum of overrun (which would also help solve the current agitation dredging problem). This could best be done with long straight runs through all of the shoals, keeping the dragheads on the bottom as Mr. Banks has suggested. The Corps would have to provide continuous monitoring to make sure the dredge was working in the right area. Unless some sort of electronic monitoring could be employed, Corps inspectors or Title II inspectors would be required. This could be done and should be considered.